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Exploring the relationship between scapular dyskinesia and the injury risk among overhead athletes

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ABSTRACT

Aims: The present study attempted to investigate the relationship between scapular dyskinesia (SD) and injury risk in overhead athletes and to compare the injury risks between athletes with SD and those without.

Methods: We recruited a total of 96 athletes for this study on a voluntary basis, including 18 basketball players, 64 volleyball players, and 14 handball players. Initially, we noted down their demographic and physical characteristics. Then, we assessed their SD using the Scapular Assistance Test (SAT), the Scapular Retraction Test (SRT), and the Lateral Scapular Slide Test (LSST). Moreover, we assessed their injury risks using the Functional Movement Screen (FMS).

Results: Our findings revealed SD in 29 (30.2%) overhead athletes. Moreover, 26 of these 29 athletes showed poor FMS performance with a score below 14 points, the critical threshold in the FMS. On the other hand, 63 athletes without SD demonstrated good FMS performance with a score of 14 points or more. Accordingly, we concluded a significant relationship between SD and FMS total score among our participants ($p< 0.05$).

Conclusion: Overall, we concluded that overhead athletes with SD may have significantly higher injury risk than their counterparts without SD.

Keywords: Overhead athletes, scapular dyskinesia, injury risk, functional movement

INTRODUCTION

Any changes to shoulder biomechanics may lead to unpredictable injuries, and the scapula assumes a significant role in this regard.[1] The primary task of the scapula in the shoulder is to balance muscle activation during overhead activities and to allow the bones in the shoulder complex to move in harmony. The scapula undertakes an active role in movements, such as up-down motions, protraction-retraction, internal-external rotation, and anterior-posterior tilt, for the above-mentioned task in the shoulder.[2,3] Good scapula mobility is of great importance regarding optimal upper extremity functions.[4,5]

Scapular dyskinesia (SD) is a condition characterized by the abnormal resting position of the scapula or abnormal scapular motions with the motion of the upper extremity that leads to deterioration of the scapulohumeral rhythm.[6] Scapular winging, the most commonly known abnormal scapular position, is characterized by the prominence of the medial edge. The main factor leading to scapular winging is paralysis of the thoracic longus nerve and/or scapular muscle weakness, which may be evident among those engaging in overhead activities or in various shoulder pathologies. The consequences of scapular winging may appear as loss of muscle strength, limitation of upper extremity motion, and pain.[7,8]

SD prevalently appears in overhead activities (e.g., basketball, volleyball, and handball) possibly due to repetitive overhead activities in the shoulder joint, direct traumas during competition or training, injuries to other structures of the shoulder, muscle strains, and overuse related fatigue.[9]

Predicting possible injuries in sports and taking relevant precautions seem to be a key to athletes' maintaining their performance efficiency.[10] Functional Movement Screen (FMS) is an early warning screening that can be administered quickly and conveniently in the field without the need for further laboratory tests or costly equipment to predict possible injuries among athletes.[11]

The previous research set a score of 14 points as the critical threshold in the FMS and recognized scores below this cut-off score as poor FMS performance. These studies also documented a significant relationship between an FMS score below the cut-off score and injury risk.[12-15]

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This study was conducted to examine the relationship between scapular dyskinesia (SD) and injury risk in overhead athletes and compare the injury risks between athletes who develop scapular dyskinesia and those who do not.

No study has been found in the literature showing the relationship between scapular dyskinesia and Functional Movement Analysis (FMS) scores in overhead athletes. It is thought that this study will make up for this deficiency in the literature.

METHODS

The present study was carried out at Siirt University, School of Physical Education and Sports between July-December in 2022. Those who were a) 18-35 years old, b) professional basketball, volleyball, or handball players, c) have been actively playing basketball, volleyball, or handball for at least six months, d) had a body mass index (BMI) between 18.5-25 kg/cm², and e) voluntary to participate in the study participated in the study. Yet, those who a) had undergone a surgical operation involving the musculoskeletal system in the last six months, b) had a condition that prevented performing the tests to be performed within the study, and c) had a chronic systemic disorder or a tumoral disease were excluded from the study.

Power analysis was used to decide the number of overhead athletes to be included in the study. Accordingly, Type 1 error was predicted at the probability of 5% and 80% power when including at least 80 athletes in the study. The standard deviation values reported in previous studies[16-18] were taken into account in calculating the required sample volume for the relevant significance level and desired power level.

Therefore, a total of 96 overhead athletes were recruited for the study. The Clinical Research Ethics Committee of Kirikkale University Faculty of Medicine granted ethical approval to the study (No: 2022.06.13 dated 06.29.2022). The athletes provided their written informed consent form prior to data collection. The principles of the Declaration of Helsinki in all procedures were strictly followed in this study. Then, the data was collected by administering a demographic information form for obtaining the following data: name, height, body weight, BMI, sports branch, seniority (years), dominant hand, and monthly training/competition hours.

Evaluation of Scapular Dyskinesia

The participating athletes' SD was evaluated by using the Scapular Assistance Test (SAT), the Scapular Retraction Test (SRT), and the Lateral Scapular Slide Test (LSST).

In the SAT, the athletes were positioned with their backs to the researcher. The scapula was supported by an upward rotation motion during active shoulder flexion. If this support led them to have increased arc of motion, increased or decreased pain, the test result was considered to be positive.[3,19]

In the SRT, the athletes were positioned with their backs to the researcher, and the researcher took his position by them. The scapula was stabilized in the retraction position. If symptoms caused by labral injury or internal impingement were relieved when the scapula was in the retraction position, the test result was regarded positive.[20]

In the LSST, the athletes were positioned with their backs to the researcher. The assessment was done in three different arm positions: 1) neutral position with arms hanging by the body, 2) hands on the waist with thumbs facing back, and 3) shoulders in bilateral abduction and arms in maximum internal rotation. In these three different positions, the distance between the lower angle of the scapula and the spinous processes of the thoracic vertebrae was measured bilaterally using a tape measure. Then, SD was marked as "present" if detecting a difference greater than 1.5 cm between the two sides during the measurements.[21]

Evaluation of the FMS Scores

Each movement pattern was scored between 0-3 according to the quality of movement and pain status. Next a FMS total score was calculated by summing the scores from seven movement patterns in the test. While two of these seven basic movements in the test (deep squat, trunk stability push-up) were evaluated unilaterally, the others (hurdle step, inline lunge, shoulder mobility, active straight-leg raise, and rotary stability) were assessed bilaterally. Accordingly, only lower-scored one was considered to be among the bilaterally evaluated movements.[22-24]

Statistical Analysis

Shapiro-Wilk test was used to explore the normality of distribution. Spearman correlation coefficient was calculated for the relationship between scapular dyskinesia (SD) and injury risk. The analyses were carried out by using the IBM SPSS Statistics v.22 program and accepted a p-value < 0.05 as statistically significant.

RESULTS

Table 1 presents the participating athletes' demographic and physical characteristics.

Table 1. Athletes' demographic ve physical characteristics

	M	Median	SD	Min.	Max.
Age	22.32	22.00	3.04	18	34
Weight	68.66	68.50	7.97	51	85
Height	1.73	1.75	0.09	1.57	2.05
Body mass index	22.66	22.90	1.72	18.52	25.00
Seniority	4.04	4.00	2.02	1	9
Training hour	29.57	30.00	13.88	10	80

As shown in **Table 1**, the mean age of the participants was 22.32±3.04 years with a mean weight of 68.66±7.97 kg. and a mean height of 1.73±0.09 m. In addition, the findings revealed their mean seniority (years) to be 4.04±2.02 years, while the mean monthly training hour was found to be 29.57±13.88 hours.

Table 2 summarizes the results of the SD assessment for the athletes

Table 2. Results of the SD assessment for the athletes

	n	%
LSST 1st Position (≥ 1.5 cm)	26	27.1
LSST 2nd Position (≥ 1.5 cm)	20	20.8
LSST 3rd Position (≥ 1.5 cm)	25	26
SAT-Dominant (+)	29	30.2
SAT-Non-dominant (+)	8	8.3
SRT-Dominant (+)	29	30.2
SRT-Non-dominant (+)	8	8.3

SD was discovered among 27.1% of the athletes in the 1st position, 20.8% in the 2nd position, and 26% in the 3rd position in the Lateral Scapular Slide Test (LSST). Moreover,

the Scapular Assistance Test (SAT) and Scapular Retraction Test (SRT) positivity was found to be 30.2% on the dominant hand and 8.3% on the non-dominant hand.

The compatibility results of the tests for SD are presented in Table 3.

Table 3. Compatibility results of the tests for SD

	n	%
Lateral Scapular Slide Test (LSKT) (+)	29	30.2
Scapular Assistance Test (SAT) (+)	29	30.2
Scapular Retraction Test (SRT) (+)	29	30.2

Among the overhead athletes included in the study, 29 were consistently positive in three different tests assessing scapular dyskinesia (SD). In other words, the findings of 29 athletes with SD were found to be compatible with each other.

The athletes' FMS results by their SD status are given in Table 4.

Table 4. The athletes' FMS results by their SD status

	Overhead Athletes		r	p
	With SD (n=29)	Without SD (n=67)		
FMS Total Score <14 (Number of Cases)	26	4	.829	.000*
FMS Total Score ≥ 14 (Number of Cases)	3	63		

* p<0.05; r: Spearman correlation coefficient

The majority of the athletes with scapular dyskinesia (SD) (n=26) were found to show poor performance with a score below the critical threshold in the Functional Movement Screen (FMS). On the other hand, 63 athletes without SD demonstrated good FMS performance with a score of 14 points or more. Accordingly, a significant relationship between SD and FMS total score was found out among the participants ($p < 0.05$; $r=0.829$).

DISCUSSION

The present study was conducted to explore the relationship between SD and injury risk among overhead athletes and compare the injury risks of those with SD and those without. The relevant literature seems to miss the relationship between SD and the FMS score among athletes engaging in overhead activities.

The literature offers a plethora of SD assessment methods; nevertheless, there is still no consensus on what method had better be utilized. Given the hot discussions in the literature, not only a single method was used to assess the participants' SD. Instead, the SAT, the SRT, and the LSST were conducted for this purpose. The findings revealed high compatibility between the results of these three assessment methods.

In the study, It was detected SD in 29 (30.2%) of the 96 athletes, overlapping the previous research. Given similar studies in the literature, Maor et al.[25] discovered SD among 30% of the young competitive swimmers in pre-training. In addition, Hickey et al.[26] found that 38.2% of the asymptomatic athletes had SD. The results of the LSST yielded an SD in 27.1% of the athletes in the 1st position, 20.8% in the 2nd position, and 26% in the 3rd position. Moreover, it was discovered that SAT and SRT were positive to be 30.2% on the dominant hand and 8.3% on the non-dominant hand. In their study, Ercan et al.[27] concluded SD presence at the rate of 34.4% in the 1st position, 34.4% in the 2nd position, and 36.7% in the 3rd position in the LSST. In the same study, it was 28.6% vs. 27.7% on the dominant hand and 8.7% vs. 5.5% on the non-dominant hand in the SAT and the SRT, respectively.

The previous research set a score of 14 points as the critical threshold in the FMS and recognized scores below this cut-off score as poor FMS performance. These studies also documented a significant relationship between an FMS score below the cut-off score and injury risk.[12-15] When it comes to the results of the present study, it was concluded that 26 of 29 athletes with SD showed poor FMS performance with a score below 14 points. On the other hand, 63 athletes without SD demonstrated good FMS performance with a score of 14 points or more. Accordingly, a significant relationship between SD and the FMS total score was found out among the participants.

The fact that three-dimensional analysis methods were not used to evaluate the scapular dyskinesias of athletes doing overhead activities can be considered as a limitation of the present study.

CONCLUSION

Overall, it was detected SD in 29 (30.2%) of the 96 overhead athletes included in the study. Moreover, 26 of these 29 athletes showed poor FMS performance with a score below 14 points, the critical threshold in the FMS. On the other hand, 63 athletes without SD demonstrated good FMS performance with a score of 14 points or more. Accordingly, it was concluded a significant relationship between SD and FMS total score among our participants ($p < 0.05$; $r=0.829$).

In light of the present findings, it was concluded that overhead athletes with SD may have significantly higher injury risk than their counterparts without SD.

Since the risk of injury for athletes with scapular dyskinesia who perform overhead activities is higher than those who do overhead activities without scapular dyskinesia, more comprehensive protective approaches should be adopted to prevent possible injuries for these athletes with scapular dyskinesia.

ETHICAL DECLARATIONS

Ethics Committee Approval: The study was carried out with the permission of Kırıkkale University Faculty of Medicine Clinical Research Ethics Committee (Date: 29.06.2022, Decision No: 2022.06.13).

Informed Consent: All patients signed the free and informed consent form.

Referee Evaluation Process: Externally peer-reviewed.

Conflict of Interest Statement: The authors have no conflicts of interest to declare.

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